THESIS

for the

Degree of Doctor of Medicine

"AGE and WORK" - a Study of 489 Men in Heavy Industry

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with Honours 1954

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PREFACE

The object of the research reported in this thesis was to determine the relationship between Age and Heavy Work. The Employment of Older People is already a national problem of great importance; in the foreseeable future it will become of critical importance. The economy of Great Britain rests mainly on the prosperity of its heavy industries which will in the years to come rely more and more upon the labour of an ageing population.

The adaptation of industrial production to suit an ageing labour force depends largely on knowledge of what constitutes suitable work for older people. As yet that knowledge is embryonic but over a long period there has existed the belief that heavy work is contra-indicated for men in the upper age-groups; that belief may be the cause or the effect of a familiar event in heavy industry - moves to less heavy work by older men. As a former industrial medical officer, the author was struck by the common association between that event and health; the finding that work modification and its attendant circumstances had not been adequately investigated /

investigated led to this study.

The study was made with the assistance of a full-time grant from the Medical Research Council and during its conduct the author was under the general supervision of Professor Sir Frederick Bartlett at Cambridge University. The location of the work was centred on the Department of Social Medicine at Glasgow University.

The actual observations are derived from personal interviews with 489 men aged 50 years and over who were employed in a coalmine and two iron foundries. The outstanding findings are that with advancing age the proportion of men on heavy work falls, that moves off heavy work increase sharply in frequency after the fourth decade of age, and that injury and illness are associated with almost two thirds of these moves. The role of health factors in work modification is discussed in detail and the hypothesis is advanced that moves off heavy work are often the result of a combination of circumstances in which disability is of minor importance.

The /

The relation between retirement and modification is discussed and attention drawn to the fact that older people frequently encounter difficulty at work some years before normal retirement age is reached. The conclusion is reached that some modification of effort is required for older people but that this should not involve sacrifice of productive skills.

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INTRODUCTION

In recent years there have been important indications of the high-level concern with which the Employment of Older People is viewed.

(1) The Report of the Royal Commission on Population drew attention to the expected large increase in the numbers of people in the upper age groups and emphasized the economic need for greater use to be made of their productive capacity.

(2) Parliament devoted a day to discussion of the Employment of Older People, following which a National Advisory Committee was formed by the Minister of Labour.

(3) Leading newspaper editorials have endeavoured to awaken the public mind to the urgent need for constructive thought on the best ways of prolonging working life.

(4) Scientific research has been extended into many aspects of Age and Work.

Of the numerous expressions of future demographic trends in Britain, none is more starkly realistic than the Royal Commission calculation that:

"The /

> "The cost to the Exchequer of retirement pensions, making no allowance for any future fall in mortality, is estimated (at pension rates current in 1948) to increase from £238 millions in 1948 to £501 millions in 1978".

It needs no great knowledge of economics to understand the implications of such a forecast. The standards of living of the nation cannot be maintained, let alone raised, unless the total amount of wealth produced is increased and to that end a major contribution must come from the postponing of retirement beyond the present accepted ages.

If older people are to be retained in industry suitable work must be available to those who are fit, willing, and possess or can acquire the necessary skills, but the problem of retention is not confined to those of pensionable age and over. There is evidence to show that it may arise some years earlier; Table 1 is taken from figures supplied by the Ministry of Labour.

TABLE 1 /

TABLE 1

Age and Unemployment - Males Only, June, 1950

AGE GROUP	ESTIMATED TOTAL NUMBER OF EMPLOYEES	NUMBER REGISTERED AS WHOLLY UNEMPLOYED	% UNEMPLOYED
15-20	1,290,000	15,780	1.2
21-40	6,226,000	67,635	1.1
41-50	3,018,000	38,208	1.3
51-55	1,117,000	22,503	2.0
56-64	1,563,000	45,839	2.9

There is a clear rise in the rate of unemployment in the fifties and sixties, indicating that older people who have given up one job find increasing difficulty in obtaining another.

From the 1950 Social Survey on Older People and Their Employment came the finding that the average age at retirement of a fairly representative sample of men aged 55 to 74 years was 62 years; this lends support to the view that the main wastage in the labour force takes place earlier than is commonly supposed. Various reasons may be adduced in explanation of these trends but pride of place should /

should probably go to prejudice, either on the part of employers or amongst the older people themselves.

That some employers are unwilling to engage older workers is wellknown; two recent reports have given some idea of the extent of this prejudice. The Industrial Welfare Society investigation (1950) revealed that of 400 member firms only 45% stated that they would employ new men aged 65 and over and the 1950 Survey by Thomas and Osborne showed that only about 50% of a random sample of British employers were in favour of engaging new workers aged 45 years and over. Why this prejudiced attitude should be so widespread can only be speculative but prejudices do not usually grow up out of nothing and it is likely that, in the past when work was less plentiful, employers were for socio-economic reasons obliged to discriminate against older people. With the passage of time this attitude may have hardened into an accepted part of managerial policy.

Prejudice on the part of older workers is difficult to prove but there is reason to believe that a selective attitude towards new work is fairly widespread among those who become unemployed in their /

their later years. Fear that certain kinds of work are too heavy does undoubtedly lead to a rejection of jobs offered to them and in addition their uncertainty about learning capacity for new jobs sometimes appears to be a reason for continued unemployment.

Whatever the whole truth may be, the fact remains that the core of the modern problem is how to retain and regain older workers in industry. A first step toward solution is the determination of what constitutes suitable work for older people.

SUITABLE WORK

The search for a definition of the work appropriate to older people as a group consists basically of the discovery of changes with age in psycho-physiological function. Since the measurement of any human function is a measurement of range, that definition must necessarily be a general one within which the problem of work suitability for a given individual will be solved by present and future methods of vocational selection.

In matters of Age, this individual variation is of particular importance. Both experimental and /

and field research have shown that with increase in age the average performance or activity tends to fall and the scatter round that average tends to increase. Unless this fundamental fact is remembered there is a danger that suitable work for older people may be too tightly defined in terms of the average, with inevitable detriment to those individuals whose potentialities lie well above or below that average.

In the following pages an attempt is made to define broadly the kind of work which appears to be most suitable for older people in terms of Skill, Fitness and Motivation. For convenience these three variables are dealt with separately but it is obvious that real life situations represent the product of interactions between them, and therefore the ultimate definition of Work-Suitability will be a synthesis composed of contributions from psychology, physiology and sociology.

AGE and SKILL

The fundamental, as opposed to the utilitarian, sense of the word skill is a comparatively recent concept and represents a new outlook in experimental /

experimental psychology. Whereas formerly performance was tested on isolated parts of a whole activity, in the last decade that approach has been replaced by one in which several related components are brought together in a single test situation, thus permitting the analysis of complex behaviour both in terms of total achievement and method of achievement.

Before reviewing the effects of age on skill revealed by this new approach, it is necessary to consider briefly what is understood in experimental psychology by the word 'skill'. According to Welford (1950) two main processes are involved in skilled activity; a receptor mechanism which is concerned with the organisation and interpretation of information obtained from the sense organs and second, an effector mechanism which has to do with the translation of the receptor-processed data into action. Skilled performance consists of a smooth interlinkage between receptor and effector phases and, since the action which results - be it thought, word or deed - itself provides a further stimulus to the sense organs, also of a similar connection between effector and receptor phases. Within this continuous process a skill has to be learned by the building up /

up of the correct responses to a repeated situation; in the acquisition of experience, organisation of the incoming information is of paramount importance and appears to operate by a process of selection, that which has gone before being related to that which is present. Gradually a repertoire of experience is established from which the response conditioned by a given stimulus can be drawn, and with the passage of time the organisation of experience becomes firmer allowing conscious control to drop out. A further consequence of the development of experience is that less information is required to evoke the correct response to a stimulus or rather to a series of stimuli thus permitting performance to be maintained with less effort.

It is obvious that by its nature, ageing is a process which is closely bound up with the acquisition and maintenance of skill. To understand the relationship between age and skill an experimental approach is necessary for only in a controlled situation is it possible to measure the difference with age in both total achievement and method of achievement on a highly complex task.

Since /

Since 1947 the Nuffield Unit for Research into Ageing has been engaged in such an experimental approach. The results have been reported by Welford from whose publications the following results have been taken.

THE CAMBRIDGE EXPERIMENTS (Welford 1950)

To a series of complex laboratory tasks were brought men ranging in age from the twenties to the seventies. It was clear at the beginning both that previous occupational experience might influence the level of performance on particular tasks and that older subjects might be less inclined to exert their maximum capacities because of the widespread suspicion which 'tests' tend to evoke. Perusal of the reports suggests that all possible steps were taken to reduce these disturbing influences to a point where no serious interference was likely.

The experiments were designed to form a series thereby permitting a gradual increase in complexity whilst at the same time retaining those features which the nature of skill suggested were of importance. This approach was amply justified by the findings, an outstanding feature of which was the repetition in /

in varied tasks of the same age trends.

Taking the findings from the various experiments as a whole, three outstanding conclusions are justifiable:

(1) Although the general level of performance deteriorated with increasing age, it was clear that the extent of decline depended on the nature of the task set. When an objective could be reached in one of several ways, it was observed that older people could often maintain a level of achievement little different to that of younger people but when method of achievement was constrained to a rigid pattern, deterioration tended to set in.

This was well illustrated in respect of speed. Whereas younger men as a group worked at higher speeds and made numerous errors, older people either preferred or were forced to proceed more slowly but made fewer mistakes. It seemed from other experiments that this slowing up was due to a genuine fall in the capacity to keep up rapid rates of performance and that the higher accuracy represented a process of compensation whereby total achievement could be maintained. When the task was altered to impose a rigidly paced speed of performance on the subjects, the older men showed an earlier breakdown in achievement due apparently to the absence of alternative methods by which a compensatory increase in accuracy could operate.

This compensation emerged as one of the fundamental features of the series of experiments.

(2) /

(2) A major difficulty for the older subjects lay in comprehension of the situations confronting them especially when these contained novel or confusing features. From the analyses of the various test scores it appeared that with increase in age, the organising function of the receptor component of skill became less efficient, in that past experience tended to obtrude itself in situations where it was not appropriate. That is to say where no relevant past experience was available, older people were less able than those younger to get away to a new comprehension of what was presented to them. To some extent this difficulty was offset by allowing more time or more information, either of which could be considered to provide the conditions for compensation referred to above.

In addition to this particular finding other experimental evidence was adduced to show that the location of the main age changes was in the central brain mechanisms and not, as has been commonly supposed, in the sense-organs and muscles. It is therefore possible that the limitations imposed by age are mainly 'mental' rather than physical, a conclusion - tentative though it must be - which is of great importance.

(3) The third outstanding conclusion derives from the demonstration that these age-changes often begin much earlier than would be suspected if only gross manifestations were sought; as early as the late twenties changes were detected in some of the experiments. It is therefore obvious that more than the old may stand to benefit from future applications in industry of the knowledge gained from the experimental approach to ageing.

Equipped /

Equipped with the experimental hypotheses Welford and his colleagues proceeded to conduct some preliminary studies inside industry, especially with a view to checking findings obtained from performances necessarily of short duration against data from real-life tasks continued over much longer periods.

THE CAMBRIDGE STUDIES IN INDUSTRY (Welford 1950)

The investigators directed their main attention to the age distribution of workpeople on various industrial operations. No attempt was made to select operations at random, preference being given to those likely to yield the most useful results in the light of the experimental findings. In all, 95 operations were studied and from the analysis several interesting facts emerged.

Operations paid at piece-rates tended to have a younger age distribution than those paid at time-rates. Further breakdown showed that the main difference in age ranges was to be found between operations on which time-stress was present and those in which it was absent. Where the work had to be performed under pressure for speed, for instance /

instance when a conveyor belt imposed a rigid pacing on the operator, or piece-rates demanded a very high rate of working, the proportion of older people was low; but on operations paid either by time-rates or piece-rates where the speed of work was lower and more under the operator's own control, a substantial proportion of older people was commonly found.

It appeared that time-stress, especially that kind found in paced work, discriminated against older people, a finding which lent support to the experimentally determined hypothesis that decline in speed can be compensated for by an increase in accuracy. On tasks paid at time-rates or piece-rates with a low pressure for speed it is reasonable to assume that greater accuracy is possible.

Evidence of training difficulties was obtained for 15 operations; these began as early as the twenties and appeared to be greatest when the work was of the high speed repetitive kind or where the 'set-up' was complicated for the beginner. But in these same operations once the requisite skill had been learned, it could usually be maintained well into the older ages.

Considering the experimental and industrial findings of the Nuffield Unit together, it is permissible to outline the kind of work in terms of skill which appears most suitable for older people as a group.

The first requisite is that the work-tempo should be lower than that expected of younger people. Paced work, that is work where the speed of operation is outwith the individual's own control is contra-indicated; the aim should be to allow older people greater scope for accuracy and to that end some relaxation of piece-work demands is called for. To wait for breakdown in performance with age is to neglect the clearly demonstrated fact that age-changes begin early; much potential skill might be preserved if in the forties and fifties piece-rate payments were adjusted to permit a lower level of effort, thus allowing fundamental processes of compensation to operate earlier than is at present possible.

The second main consideration relates to choice of new work. Since skill is much more easily maintained than acquired in middle age, caution should be exercised in recommending or approving a change of/

of job in those who for one reason or another are unable to continue in the work to which they are accustomed. Better that some modification of the job with which they are familiar should be attempted than allow a move to work which is unfamiliar and may present training difficulties or which is much inferior in grade of skill. One obvious modification is mentioned above - a reduction in the speed of work.

The Cambridge studies are as yet very incomplete but valuable progress has been made. Of future plans (Welford 1950) that which is directed towards the discovery of the most suitable methods of retraining older men for new work will be of outstanding interest and importance. With increasing industrial mechanisation and the rapid development of new techniques, skills are all too liable to become redundant and it is therefore urgently necessary that programmes of training should be devised to meet the requirements of middle aged men whose established skills have lost their productive value.

AGE and INDUSTRIAL SKILL

The conventional use in industry of the terms 'skilled', 'semiskilled' and 'unskilled' in relation /

relation to either work or worker must not be confused with the concept of skill just reviewed. The latter is fundamental, the former is utilitarian and necessarily based upon arbitrary criteria.

This classification of levels of skill is of limited statistical value but many common beliefs have arisen from its use, a main one being that the lot of the older unskilled man is much less happy than that of his more skilled contemporary. Implicit in such a suggestion is the view that if more young people can be trained in skilled trades, the future problems of Age and Work will be correspondingly less. From an economic standpoint the claim for more skilled workers is indisputable but it is by no means certain that the problem of work-suitability for older people will be solved by an all-round increase in the number of skilled workers.

In the Social Survey by Thomas and Osborne a comparison was made between the occupations of a sample of men aged 55-74 years and those of a sample of the general male industrial population aged 18 years and over. From the definitions provided it can be assumed that 'manipulative workers' correspond with 'skilled workers' and 'operatives' with the /

the designation 'semiskilled'. The findings are shown in Table 2.

TABLE 2

Proportional Distribution of Occupations

OCCUPATION	MEN AGED 55-74 %	MEN AGED 18 AND OVER %
Professional & Technical	5	5
Managerial	27	20
Clerical	7	5
MANIPULATIVE (skilled)	14	20
OPERATIVES (semiskilled)	25	35
UNSKILLED	22	15
SIZE OF SAMPLE	1,274 100%	3,686 100%

The higher proportion of older men in managerial positions is most likely to be due to promotion. The interesting observations are the smaller proportion of older men in the skilled and semiskilled groups and the higher proportion in the unskilled group; these differences suggest that a number of men in the upper age groups have moved toward less skilled work and /

and therefore throw doubt on the view that skill and work-suitability for older people are synonymous. The terms 'skilled' and 'semiskilled' must include a very wide range of jobs and the explanation of this move to unskilled work may lie in the nature of a few selected tasks embraced by them rather than in some feature of skill as a whole.

Against the above must be set the further Social Survey finding that among men aged 55 to 74 years the incidence of long-term unemployment since age 45 varied from 26% in men whose work had been unskilled to 11% in those who belonged to the skilled group. In this respect the possession of a higher skill was evidently an advantage, yet, when a sample of employers was asked what weight they would attach to skill when engaging new workers over 45 years of age it appeared that an older skilled worker had only a slightly greater chance of employment than an unskilled worker over that age.

Despite the strong belief that skilled workers encounter fewer problems as age advances than do the unskilled, there are grounds for suspecting that this may be an overstatement. The adjective 'skilled' /

'skilled' refers only to one aspect of an industrial job; to reach a definition of suitable work for older people in terms of industrial skill seems feasible enough until it is remembered that within each grade of skill is included a large number of jobs varying widely in other important aspects. It is possible for example that two tasks of roughly similar complexity in skill may require very different amounts of effort for their execution; should a move off the heavy task be made on grounds of fitness, the change of work may be mistakenly associated with the skill.

In the search for a specification of work appropriate to older people, skill changes with age rank high in importance but no less relevant is the question of Age and Fitness. Perhaps more in this than in any other aspect of ageing is popular conviction and convention strongly entrenched; the view that 'light work' is <u>the</u> work for older people will have to be dispelled if an extension of useful working life is to be achieved.

<u>AGE and FITNESS</u> /

AGE and FITNESS

> "It must be frankly admitted that so far no reliable standard of measurement of fitness has been evolved. Many attempts have been made to assess this elusive and yet recognisable quality. Physical fitness depends on a collection of qualities, psychological as well as physiological, and it is extremely difficult to determine which combination is likely to give the truest index".
>
> Cathcart, Hughes and Chalmers (1935)

Despite intensive research, the position has changed little since these words were written. Quantitative assessment of physical fitness is still a complex and controversial problem.

Because it has not yet been possible to give a comprehensive and reliable measure of the changes with age in physical fitness, a number of vague popular beliefs have dominated the industrial scene. Not least of these is the feeling on the part of older people themselves that jobs which appear in any way 'heavy' are unsuitable, an attitude so prevalent and firmly rooted that only facts and education will change it.

It /

It is sometimes argued that increasing mechanisation is steadily reducing the amount of hard physical effort required in the heavier industries and is thereby tending to favour the continued employment of older people. Up to a point this contention is true but the general speeding up of production, also in part a consequence of mechanisation, is to some extent counteracting that advantage. To speculate on these and other matters is easy but their implications for older people can not be stated with any certainty until it is known what effect changes with age have on the capacity to perform differing kinds of work.

The response of the body to exercise is the basic principle in all tests of physical fitness. A wide range of test situations has been used and a wealth of literature is now available on the physiological response to various types of work. Many indices have been calculated but there seems to be no general agreement on how far these correlate with general or particular efficiency for real-life tasks. The application to industrial work of knowledge gained from experimental situations presents severe difficulties since the resemblance between the /

the two kinds of work is usually remote; even the simplest manual labour in industry may vary widely in the timing and nature of its demands on the labourer.

A further difficulty in the practical interpretation of test results arises from the effect of environment; even if it were possible to reproduce the mechanical components of an everyday job in a laboratory test, the influence of environmental factors, human and physical, would require consideration when the findings were to be used in industry.

It is with these limitations in mind that changes with age in physical fitness will now be reviewed. The choice of papers from the extensive literature has been made with one main end in view - the definition of suitable work for older people in terms of physical effort.

Strength tests

Tests of strength have the advantages of simplicity and mobility; motivation to do well is usually high and even those in poor health can be tested without risk. It is therefore likely that /

that a trend with age is more accurately represented by such tests than by those in which the considerable effort required may deter the less healthy from participating.

Among the earliest studies of strength changes with age are those of Quetelet (1836) and Rejs (1921) quoted by Simonson (1947); backmuscle strength attained a maximum between 25 and 30 years of age declining slowly thereafter. In the former study the level reached at age 50 was 83% of the peak value.

In 1935 Cathcart, Hughes and Chalmers reported the findings in a sample of 13,000 men drawn from employed and unemployed men and University students in Great Britain. Using a dynamometer they measured maximum hand grip and lumbar pull; the former increased up to age 20, remained uniform to about age 40 when a slow decline set in and the latter, after a peak between age 26 and 30, also fell slowly with increasing age. For both measurements the values in men above 65 years of age were just over 80% of those at the peak.

In a recent survey among 7,000 Ceylonese /

Ceylonese (Cullumbine et all. 1950) very similar trends with age were found in tests of weight lifting and hand grip; from the age of 26 to 30 for weight lifting and 21-25 for strength of grip, a slow decline was found.

There is certainly no justification in these findings for the view that older people are unable to do work in which occasional strenuous lifting or gripping is required but such tests of strength do no more than measure an isolated local ability and by themselves cannot provide evidence of total functional fitness. Only by subjecting the body to exercise requiring considerable expenditure of energy is it possible to obtain indices likely to bear a useful relation to general functional efficiency.

Fitness tests

An individual can do work in proportion to the efficiency of his oxygen uptake - utilisation mechanism. Many tests have been devised for the study of this function but broadly speaking they appear to fall into two groups - those which require moderate effort and those which require maximal effort. According to Johnson (1946), if the performances of unquestionably /

unquestionably fit and unfit men are compared at these two levels of effort, the indices of oxygen consumption, pulse rate, blood pressure, and blood lactate taken together show that the fit man carries on a given grade of moderate work at a lower physiological cost and has better recuperative powers in the sense that after a bout of exhaustive exercise (maximal effort) he returns to his resting state more quickly.

That the effect of age is to lower the average level of fitness, as measured by these indices, is shown by two studies, one intensive the other more extensive.

Using as subjects 93 'normal' non-athletic American males ranging in age from 6 to 91 years, Robinson (1938) observed the physiological state of circulation and respiration before, during, and after moderate and exhausting work on a treadmill. His findings are summarized below:

(1) On moderate exercise the average heart rates of older men showed slower acceleration, higher values during work and a slower recovery of resting values. On severe exercise acceleration and recovery again declined with age but the maximum rate attained during work was lower in the older men.

(2) /

(2) Lung ventilation was higher in older men on moderate work but in severe exercise the maximum ventilation was much lower, the maximal oxygen intake being about 50% below that of younger men.

(3) Blood lactate levels were higher over 40 years of age on moderate work but at the severe levels of exercise the oldest men showed low levels largely because they tended to stop short of the most gruelling activity.

The conclusions from Robinson's study seem to be firstly that older men have a substantially lower capacity for maximal effort of short duration, secondly that when the effort is submaximal and of short duration older men require greater use of the cardio-respiratory system to achieve a steady state, and thirdly that at both levels of effort the circulation is slower in adapting from rest to work and recovery from the exercise takes longer as age increases.

Cullumbine (1950) measured the pulse rate and systolic blood pressure of over 3,000 Ceylonese males during recovery from step-tests of both moderate and severe exercise; the duration of exercise divided by the sum of the observations at selected intervals in the recovery period gave fitness indices from age 10 years to age 40-50 years. These indices declined /

declined from age 21-25 for each grade of exercise but whereas on moderate exercise the value at age 36-40 was 92% of the value at age 21-25, on severe exercise this proportion fell to 77%. Again it is clear that with increase in age the capacity to tolerate exercise is steadily reduced.

The findings when other indices of performance have been used show the same trend with age.

Simonson (1947) tested the performance in several types of work of a group of 25 younger men (average age 33 years) with that of a group of 11 older men (average age 53 years); both groups were requested to run at maximum speed until exhaustion. The speed, total time and distance run were much lower in the older men.

Shock (1947) using measurement of oxygen consumption after maximal exercise showed that whereas a young adolescent can recover completely by the end of 30 minutes, young adults required three to four hours for recovery from a comparable amount of exertion.

Hugh-Jones (1952) demonstrated that the increased breathlessness of ageing is due to a decrease in the ventilatory reserve as measured by the maximum voluntary /

voluntary ventilation; this index declined by 22% between the ages of 25 and 55 years.

Although it is beyond dispute that fitness in terms of these various measurements is reduced as age increases it is not easy to judge how far the findings may be used to define suitable work for older people; in industry maximal work is rarely required and where the job demands are moderate the effort is intermittently exerted over a period of hours. The evidence however points clearly to the general conclusion that the effect of ageing is a gradual lowering of the capacity for effort and therefore the heavier the industrial task the more does its performance encroach with increase in age on the physiological reserves.

Since older people require longer to recover from exercise it is justifiable to infer that for them rest pauses should be more frequent but where this is difficult to introduce the level of continuous effort should be lowered. It is in striking the balance between level of effort and continuity of effort that precise definition is impossible; little is known in scientific terms of the demands of different industrial /

industrial jobs and until that knowledge is forthcoming the relation between fitness measured in the laboratory and fitness for actual industrial work cannot be accurately known.

Training

It is well known that training can improve performance on tasks requiring strenuous effort. In an interesting experiment Crowden (1927) showed that the physiological cost of the muscular movements involved in wheeling barrows of bricks could be cut by as much as two-thirds by training. Robinson (1938) quotes several observations on athletes which indicate that training substantially improves the economy of effort with which a given task is performed.

This effect of training seems important in that older men whose lives have mainly been spent on heavy work are likely to be more physically able to do active work than are those accustomed to more sedentary occupations, a consideration of some value in reaching a definition of suitable work for a large group in the population.

In concluding this brief review of Age and Fitness, it is necessary to recall the place of the individual. The changes discussed represent the trend of the average with increase in age; where an individual lies in relation to that average must depend on many factors some at present assessable, some not. For the fortunates no adjustment of the physical demand of work will be necessary as age advances but for those in whom a declining reserve necessitates some reduction in effort, it is earnestly to be hoped that simple reliable tests will be devised from which accurate individual guidance can be given on the amount of physical effort compatible with individually demonstrated ability. That guidance coupled with increased knowledge of the physical demands of industrial work will help to ensure that, within the appropriate range of skill, older people are so placed in work that their efficiency and self-respect are maintained or even increased.

AGE and MOTIVATION /

AGE and MOTIVATION

"The spirit truly is willing but the flesh is weak" is a poor text; if the spirit can endure, the flesh will usually find the capacity to do so". Thus wrote the late Lord Wavell. In time of stress the truth of these words has often been evident but in the world of industry where so much of the work done offers so little opportunity for satisfaction it is perhaps not surprising that many older men show little inclination to work beyond the age at which pensions become payable.

Since motivation is the result of a complexity of influences the effect of ageing upon it is difficult to assess. The scientific study of motivation has only just begun (Bartlett, 1951) and where facts are few, opinions are many. Much has been asserted in speech and writing but too often the claims are based on experience of a small and selected sample.

A succession of speculations on the attitude to work of older people can serve no purpose. The crux of the problem is how to maintain and improve the attitude to work of older people so that with due /

due regard to skill and fitness they may continue to be active producers of wealth beyond present accepted retirement age. There is wide scope here for experiment; a few enlightened firms have in recent years tried to encourage the useful employment of their own elderly men by creating special work or working environment but much of value will be lost unless these experiments are carefully observed and accurately reported.

It is not yet possible to add motivational specifications to the meagre definition of work-suitability already given in relation to Skill and Fitness, but changes with age in willingness to work and interest in work can never be studied in isolation. There is no doubt that Skill, Fitness and Motivation interact in real life to produce an infinite number of variations between individuals and variation within an individual at different moments of time; the investigation of one overlaps the investigation of the others.

AGE and INDUSTRY

In the foregoing pages a very imperfect attempt has been made to see how far suitable work for older people can be defined in terms of existing knowledge on Skill, Fitness and Motivation. It is clear that what is known is small beside what is not known and though further contributions will come mainly from experimental approaches it is important to know what methods industry adopts to meet the existing demand for work suitable to its older members.

The Employment of Older People has always presented problems to Industry. In time of labour abundance the immediate solution was simple but in recent years there have been signs that the more enlightened firms are beginning to tackle the problems with a view to adjusting their production to an ageing labour force.

The nature of these problems varies. In many lighter industries the difficulty for older people lies in the realm of skill rather than fitness, in the heavy industries decline in fitness assumes greater importance, and there are all gradations between. More prominence has been given to some aspects of the overall problem than to others, but /

but there can be no doubt that the relation between Age and Heavy Work is one that requires urgent attention. The justification for that contention lies in the simple fact that the British economy rests largely on the prosperity of its two heaviest industries - coalmining and iron and steel.

AGE and HEAVY WORK

This is surely one of the most frequently discussed aspects of the general problem of the Employment of Older People. It is generally accepted that heavy work is unsuitable for the majority of men in the upper age-groups but beyond that generalisation there is surprisingly little evidence of what does happen in those industries where the heaviest jobs are to be found.

Since there is no precise definition of heavy work widely applicable in industry it is difficult to obtain a clear picture of the relation between age and work heaviness. It is usually said that the heavy industries cannot employ many older men but there is evidence that this is by no means a wholly /

wholly accurate statement. The Industrial Welfare Society's Report (1950) on 400 of its member firms showed that whereas the number of men over 65 years of age expressed as a proportion of all men employed by these firms was 2.7%, the proportion in two heavy industries, Tin and Sheet Steel, was 4.7%. In a survey of the age distribution of 110,000 men employed by 42 firms in the Iron and Steel Industry, Fleming (1952) found that the average proportion of the labour force aged 65 years and over was 4% with a range of 0.7% to 11.3%. These observations reveal the need to distinguish between heavy industry and heavy work.

There is very little information about older people and heavy jobs. Belbin and Sewell (1949) studied age distributions on a number of industrial operations included among which were "..... operations involving considerable muscular effort in the handling of heavy materials etc., and operations involving a degree of activity which made them regarded as heavy in the factories concerned".

The conclusion reached was that many of the heavy jobs were carried out by older people, particularly those where time rates were paid or where the effort was intermittent. On jobs which /

which required continuous heavy exertion few older men were found and definite evidence was obtained of moves off these jobs in the fifties.

Industry is familiar with this problem of moves off heavy work with increasing age. The provision of alternative work is often difficult and men may be forced to retire simply because suitable work is not available. In a follow up study of the return to work of male hospital patients aged 50-64 years Pemberton and Smith (1952) found that those who had been employed in the coalmining and steel industries had severe difficulty in obtaining work suited to their capacity. It is important to note that this problem does not only arise at the retirement age of 65; indeed there is reason to believe that it appears some years earlier. Thomas and Osborne (1950) reported that the average age at which full-time employment had been given up by a sample of men between 55 and 74 years of age was 62 years. In the Parliamentary debate (Hansard 1951) on the employment of older people it was claimed that in the mining industry most of the men have to cease work at the coalface by the age of 55.

The /

The whole subject of Age and Work is ripe for study. All are agreed that more older people will have to extend their useful working life and the problem of how this is to be done seems most acute in the field of heavy work. Until much more is known about the effects of age on Skill, Fitness and Motivation, the correct policy for older people in industry cannot be known but meantime it is important to try to give some precision to what are at present very general impressions. That endeavour is a challenge to many branches of knowledge but not least to Industrial Medicine.

The study reported in the following pages was designed to throw some light on the relation between Age and Heavy Work by seeking an answer to four main questions.

(1) Are older men doing less heavy work?

(2) At what age do they move off heavy work?

(3) With what factors are these moves associated?

(4) What is the state of health of older people in heavy industry?

OBSERVATIONS

METHOD OF STUDY

To obtain answers to these questions on older people and work-heaviness, two main sources of information had to be tapped. The first of these - industrial records - was a doubtful line of enquiry by itself in view of the wide variations in industrial personnel practice and it was therefore decided to base the study largely on the second source - older people themselves. A personal interview was chosen in preference to a questionnaire in the hope (later justified) that both quantity and quality of information would be greater.

Three methods of approach seemed to merit consideration:

(1) The cohort

A group of men of about the same year of birth and all originally employed in the same heavy occupation could be followed up in retrospect. Moves to less heavy work and retirements would be noted along with the ages at which these events took place. Were this method feasible, accurate and complete information would be available on the extent of work modifications and labour force losses.

Even /

Even if it had been possible to obtain the necessary records of the original group, the task of tracing and interviewing those left at each period was quite beyond the facilities available.

(2) The random sample

Given a well defined area in which heavy industry predominated, samples of men at different ages could be drawn and divided into those at work and those retired or unemployed. By studying health and work, both in the present and the past, a comprehensive answer would be obtainable to the questions posed.

Unfortunately no such area was known to be accessible and again the labour involved would have been too great for a single investigator. In fact preliminary attempts to gain access to unemployed and retired men proved so fruitless that the third approach was the one chosen.

(3) Selection of factories

Having in mind the variation which surrounds the interpretation of 'heaviness' in work and the need for good relations to be established quickly with men and management, the decision was made to approach the study via two industries where it was probable that a relatively high proportion of the jobs belonged by common consent to the 'heavy' category.

The final selection of two iron foundries and a coalmine was made on the advice of acquaintances of the author, it being known in advance that the attitude of the managements was likely to be /

be favourable. Preliminary consultations with representatives of employers and employees were held, the necessary facilities were granted and interviewing began.

The Interviews

It was necessary at the outset to define the age range within which men were to be interviewed. Some previous experience of the investigator as a medical officer in the steel industry suggested that a lower limit of 50 years of age would cover those men likely to yield the information required and this limit was also satisfactory in that from the age distribution of the foundries and coalmine it provided a sufficient number of men for interview in one complete year.

Accordingly only men aged 50 years or over on their last birthday were asked to come for interview. The actual meeting took place during working time, arrangements being made that piece-workers' earnings would not suffer from the 15 to 30 minutes absence from their jobs. Neither compulsion nor persuasion was used to bring men for the interview which was conducted in complete privacy.

Information /

Information was sought on the following points:

(1) Age last birthday in January, 1951.

(2) Health

The first part of the interview was devoted to the individual's health in the belief that since people in the presence of a doctor, albeit a complete stranger, talk readily on that topic, rapport would be more quickly established.

(a) Past Health

The date, duration and nature of all illnesses and injuries which had caused absence from work for more than one month were requested.

(b) Present Health

The actual replies to the question "What is your present state of health?" were recorded, the aim being to discover the individual's own opinion of his health.

(c) Symptoms and disabilities at the time of interview and whether these were receiving medical attention.

(d) Change of work on health grounds at any time in the past.

(3) During interview, the general physical appearance, any disabilities, and the attitude of the individual to the questions was observed.

(4) /

(4) Occupation

(a) Past Work History

Each man was asked what kind of work he had done since age 20. Class of work was sought rather than a detailed description of every job; the questions were devised to ascertain level of skill attained, the physical effort required, the length of time on each job, and whether and for what reason a move to less heavy work had been made.

(b) Present Work

Under this heading a description of the activity entailed in the job held at the time of interview and his opinion on its heaviness and general suitability in relation to his age were invited from the interviewee.

As soon as possible after each interview a visit was paid to the individual's place of work; no job analysis was attempted but from personal observation, each job was placed in one of three grades of physical effort. Interviews were never discussed with supervisors, foremen or managers, but useful gratuitous information was often offered by them and their opinion on the 'heaviness' level of jobs was always sought before assigning a task to its particular grade.

THE STUDY MATERIAL

The men interviewed were drawn from three industrial groups.

1. The Large Foundry

A wide range of solid fuel cooking and heating stoves was produced, there being two main stages in manufacture -

(a) The making of components in the foundry

(b) The assembly of components in the factory

In both sections of the works, much handling of components was necessary and in general the level of physical effort appeared to be considerable.

The firm was in its 98th year of existence and had strong local traditions; it lay on the edge of an industrial area in which foundries, brickworks and coalmines were the chief places of employment.

879 male non-staff weekly wage earners were employed; of that total, 244 were aged 50 years or over. 223 were interviewed, the other 21 being accounted for as under:

Reason /

Reason	No.
Refused interview	1
Sickness absence throughout period of study	6
Left employment before interview arranged ...	7
Severe stutter	1
Deaf Mute	1
Constant night-shift	5

The managerial policy for older non-staff workers was one of active encouragement to remain at work until age 70 when, with the occasional exception of a highly skilled tradesman, all workers were retired. A small (non-contributory) pension was usually paid in retirement.

2. The Small Foundry

Located one mile from the first foundry, the products and methods of manufacture were very similar. Though managed independently there was an agreement between the two firms which standardised the technical processes.

Also /

Also a long established firm, there was in January 1951 a total of 324 male non-staff weekly wage earners, of whom 68 were aged 50 years or over; 66 were interviewed, one man having left before his interview was due and one being absent through illness.

A small pension was paid to retired servants of the firm but no age-limit was put on those who were fit and willing to do useful work.

3. The Coalmine

One of the largest in Scotland, it employed 1,450 men and had been in production for 30 years. By comparison with other pits, it had been less affected by economic vicissitudes and was reckoned to have a fairly stable labour force.

339 men were listed as being aged 50 years or more, and of these 200 were interviewed. Whereas in the foundries no serious obstacles were encountered in obtaining a 90% sample for interview, access to about one third of the miners was either impossible or so difficult that the attempt to obtain a representative sample had to be abandoned.

Eventually /

Eventually a simple selection procedure was adopted. From a list of dates of birth, men aged 50 years and over were asked in sequence to attend for interview and if available and willing they were seen. There were two refusals. At least 43 men were not available through sickness absence and 12 had left to work elsewhere.

The colliery manager took the view that since no rigid age for retirement was laid down by the National Coal Board (the miners' pension scheme had not then begun) older men should be given encouragement to remain at work so long as they retained a useful capacity for doing so.

FINDINGS

In the following pages the results from the total of 489 interviews are presented.

1. Work Heaviness

The definition of heavy, medium and light work was of necessity on arbitrary grounds. Mention has already been made of the method, based on personal /

personal observation and the opinions of workers and supervisors, by which the grading was made but a few comments are here appropriate.

Extremes were readily recognisable; jobs in which the effort required was either severe or slight unanimously belonged to the heavy and light categories. Between these limits most of the jobs were graded without much difficulty but there were instances where correct grading became problematical. In such cases accuracy was impossible but by dint of repeated comparisons between these doubtful jobs a consistent grading was achieved; this source of error was probably not very serious since in both the foundries and the coalmine there was a relatively small number of defined occupations within which variation could occur.

Table 3 sets out the work-heaviness distribution by age groups.

TABLE 3 /

TABLE 3

WORK DISTRIBUTION BY AGE GROUPS

H = Heavy M = Medium L = Light

AGE at INTER-VIEW	SMALL FOUNDRY WORK				LARGE FOUNDRY WORK				COAL MINE WORK				TOTAL INTER-VIEWED
	H	M	L	Total	H	M	L	Total	H	M	L	Total	
50-59	6 15%	22 53%	13 32%	41 100%	41 31%	64 49%	27 20%	132 100%	73 60%	33 27%	15 13%	121 100%	294
60-69	1 5%	16 76%	4 19%	21 100%	16 19%	41 49%	27 32%	84 100%	17 26%	24 36%	25 38%	66 100%	171
70-79	-	2 50%	2 50%	4 100%	-	4 57%	3 43%	7 100%	1 8%	7 54%	5 38%	13 100%	24
All Ages	7 12%	40 60%	19 28%	66 100%	57 25%	109 49%	57 25%	223 100%	91 45%	64 32%	45 23%	200 100%	489

Applying the chi-squared test to each of the three distributions we find -

Small Foundry:	n = 4	$\chi^2 = 4.41$	P greater than .30
Large Foundry:	n = 4	$\chi^2 = 8.44$	P greater than .05
Coal Mine:	n = 4	$\chi^2 = 32.58$	P less than .01

In each of the three occupational groups there is a fall from the fifties through the sixties to the seventies in the proportion of men on heavy work although only in the data from the coalmine is the difference statistically significant at the conventional level.

The separation from the labour force indicated by the sharp drop in numbers at work from the fifties onwards is due to the combined effect of mortality morbidity and retirement, (the assumption is made that losses due to men leaving to seek work elsewhere is balanced by gains from moves in the reverse direction.) If these factors, or any one of them, operated selectively on men in the heavy grade of work at a given age, then clearly the later work heaviness distributions would show a decline in the proportion of men on heavy work.

Consideration of the absolute figures provides only one faint clue to the contrary - the increase from 15 men age 50-59 to 25 men age 60-69 in the coalmine light work column. This could only be due to a redistribution of work heaviness between these ages. Therefore although it seems clear in Table /

Table 3 that from the fifties to the seventies the proportion of men on heavy work declines, an explanation of this in terms of moves to less heavy work requires analysis of the occupational histories.

2. Work Modification

For convenience, the term 'modification' has been applied to a move to less heavy work.

There was seldom any difficulty in reconciling admitted modifications with the evidence in the work history. There were however a few cases in which the two did not tally, the usual story being a vigorous denial that less heavy work had ever been sought followed by an occupational history in which the discrepancy was obvious. Care was taken to record as modifications only job-changes (whether admitted as modification or not) in which there was no reasonable doubt that less heavy work had resulted.

On this basis men were placed in one of two groups. Group I contained those men whose history showed no evidence of modification, Group II those who had modified. One source of possible error requires /

requires mention; there seemed to be an accepted tradition that older men should 'ease up', this being expressed in such phrases as "I don't get the heaviest tasks now", and "I'm allowed to take my own time". Whilst confirmation of this was sometimes obtained, such shadowy modifications were not classed in Group II.

Table 4 shows the distribution of Groups I and II by age.

TABLE 8 /

TABLE 4

INCIDENCE OF MODIFICATION IN AGE-GROUPS

Group I - no modification Group II - modification

AGE at INTER-VIEW	SMALL FOUNDRY			LARGE FOUNDRY			COAL MINE		
	Group I	Group II	Total	Group I	Group II	Total	Group I	Group II	Total
50-59	16 39%	25 61%	41 100%	68 52%	64 48%	132 100%	56 46%	65 54%	121 100%
60-69	8 38%	13 62%	21 100%	23 27%	61 73%	84 100%	13 20%	53 80%	66 100%
70-79	1 25%	3 75%	4 100%	3 43%	4 57%	7 100%	-	13 100%	13 100%
Total	25 38%	41 62%	66 100%	94 42%	129 58%	223 100%	69 34.5%	131 65.5%	200 100%

Applying the chi-squared test to each of the 3 groups:

Small Foundry:	n = 2	$\chi^2 = .31$	P greater than .80
Large Foundry:	n = 2	$\chi^2 = 12.26$	P less than .01
Coal Mine:	n = 2	$\chi^2 = 20.68$	P less than .01

No significance can be attached to the figures from the small foundry but in the large foundry and the coalmine there is a sharp increase from the fifties to the sixties in the proportion of men who had modified their work. The trend continues into the seventies in the coalmine but not in the large foundry; for this latter finding chance variation in a small sample might be responsible but, as already pointed out, a strict selection policy in terms of skill operated beyond age 70 in the large foundry.

One possible explanation of the difference between the fifties and sixties shown in Table 4 is that in respect of past work heaviness the two age groups are not comparable. If men aged 60-69 had on the whole been employed on heavier work than those ten years younger, then a higher rate of modification might be expected among them. An attempt to assess this source of error in interpretation was made by comparing the work heaviness distribution between the two age groups prior to modification. The results are shown in Table 5.

TABLE 5 /

TABLE 5

WORK HEAVINESS OF GROUP II MEN
PRIOR TO MODIFICATION

H = Heavy M = Medium L = Light

AGE AT INTERVIEW	WORK HEAVINESS PRIOR TO MODIFICATION								
	SMALL FOUNDRY			LARGE FOUNDRY			COAL MINE		
	H	M	L	H	M	L	H	M	L
50-59	17 68%	8 32%	-	48 75%	16 25%	-	63 97%	2 3%	-
60-69	10 77%	3 23%	-	49 80%	12 20%	-	52 98%	1 2%	-
	S.E. of difference between 68% and 77% = 15.5%			S.E. of difference between 75% and 80% = 7.4%			S.E. of difference between 97% and 98% = 2.9%		

There are no significant differences between the two age groups in respect of their pre-modification work heaviness, therefore the rise with age in the proportion of men in Group II must be otherwise explained.

A second possibility is along the same line as that adduced on page 49. Between the 50-59 and 60-69 age groups there is a difference, in absolute numbers of men at work, of 20, 48 and 55 in the small foundry, in the large foundry and in the coalmine respectively.

These would in a continuous study be due to mortality morbidity and retirement; assuming that no further modifications took place after age 50-59, this loss would be operating mainly on Group I to produce the proportions observed in Table 4. It can be argued that this would be the opposite of expectation in that Group II presumably contained a number of men who modified through ill-health and were therefore more likely to separate from the labour force than their fitter contemporaries in Group I.

Evidence will later be led to show that modifications were taking place at all ages and therefore the above assumption is incorrect. The conclusion to be drawn from Tables 4 and 5 is that the increase from the fifties to the sixties in the proportion of men who had modified is caused by a combination of two events, losses from the labour force and modifications within the labour force.

3. Skill and Modification

On page 16 of the introduction, reference was made to the common belief that skilled men in the older age groups encounter fewer problems than those less /

less skilled. It seemed worthwhile therefore to examine the data obtained from this study in order to see how men in the three industrial grades of skill had fared. In the coalmine the attempt to sort men into these grades had to be abandoned, there being no clear distinction even on arbitrary criteria between one level of skill and the next.

In the foundries, the classification was based chiefly on length of training period, recognition by Trade Unions, wage rates and that intangible factor 'status'. With the help of supervisors each man was placed in the appropriate group and since the two foundries were in their range of jobs very similar the data from them has been combined in Tables 6 and 7.

Table 6 contains the skill-distribution for men in Group I.

TABLE 6 /

TABLE 6

SKILL DISTRIBUTION BY AGE OF MEN WHO HAD NOT MODIFIED THEIR WORK

Foundries only

AGE AT INTER-VIEW	SKILLED MEN	SEMI-SKILLED MEN	UNSKILLED MEN	TOTALS
50-59	41 49%	25 30%	18 21%	84 100%
60-69	19 61%	7 23%	5 16%	31 100%
70-79	4 100%	-	-	4 100%
TOTALS	64 54%	32 27%	23 19%	119 100%

$\chi^2 = 4.98$ n = 4 P greater than .20

There is a considerable probability that chance variation is here responsible but if the effect of increase in age is real, there is a double explanation. The reduction from the fifties to the sixties in the absolute number of men in Group I (from 84 to 31) could be due either to men leaving the working group through retirement, death and disability without having modified or to men leaving Group I through modification and entering Group II, or to a combination /

combination of both events. (Again the assumption is made that older men who left but obtained employment elsewhere are counter-balanced by men of the same age coming from other factories to the foundries). The point to be noted is that this trend is more marked in the semiskilled and unskilled men where the 'loss' between the fifties and sixties is roughly two thirds (18 out of 25 semiskilled and 13 out of 18 for unskilled) compared with about half (22 out of 41) in the skilled group. All four men aged 70-79 years who had not modified were skilled, an expected finding in view of the selection policy operated at age 70 in the large foundry (which contributed 3 of the 4 men) whereby only exceptionally skilled were retained.

Although from Table 6 it appears that older skilled men in these foundries were more likely to remain at work and perhaps also that modification was less likely among them compared with those less skilled, consideration of the facts from Group II men revealed that at least one important group of skilled men had encountered difficulties. Table 7 shows the skill distribution before and after modification.

TABLE 7 /

TABLE 7

DISTRIBUTION OF SKILL BEFORE AND AFTER MODIFICATION BY AGE GROUPS

COMBINED DATA FROM FOUNDRIES

S- Skilled SS - Semiskilled US - Unskilled

AGE AT INTERVIEW	GROUP II BEFORE MODIFICATION				GROUP II AFTER MODIFICATION			
	S	SS	US	TOTAL	S	SS	US	TOTAL
50-59	51 57%	23 25%	16 18%	90 100%	25 28%	15 17%	50 55%	90 100%
60-69	40 55%	18 25%	15 20%	73 100%	15 20%	8 11%	50 69%	73 100%
70-79	5 71%	2 29%	-	7 100%	1 14%	3 43%	3 43%	7 100%
TOTALS	96 57%	43 25%	31 18%	170 100%	41 24%	26 15%	103 61%	170 100%

Age 50-59 - Standard Error of difference between 57% and 28% = 9.9

Age 60-69 - Standard Error of difference between 55% and 20% = 10.5

Age 70-79 - Standard Error of difference between 71% and 14% = 30.2

In the first and second rows of Table 7, the observed difference between the pre-modification and post-modification proportions of skilled men is three /

three times the standard error. This significant difference indicates that modification was frequently associated with a 'shift to the right' in skill. The close similarity between the two age groups in the pattern of skill before and after modification is striking.

The reason for this strong correlation between moves to less heavy work and drop in skill is to be found in the nature of one of the main occupations in these foundries - ironmoulding. Three fairly distinct grades of ironmoulder were recognised; all merited the title 'skilled' in the sense that a full apprenticeship of 5 years had been served but there were certain important differences. Only a small number of men were employed in the two higher grades where speed of work was slow, the accuracy demanded high and time-rates paid. The big majority of moulders were employed in the third grade where the tempo of work was fast and the work physically arduous. Some exchange between grades took place but men employed for many years in the lowest grade seldom attempted or were encouraged to attempt remastery of the higher skills; when a move to less heavy work was made, it was usually away from /

from ironmoulding altogether.

4. Age at Modification

Before the findings are discussed, attention must be given to a possible source of error inherent in the method by which information on this point was obtained. From the date of the job-change which constituted modification, age at that event was calculated by subtraction from age at the time of interview.

The accuracy with which such dates were recalled cannot be quantitatively expressed but there are grounds for believing that the estimates of age at modification are on the whole reliable. Changes of job were, in the majority of men interviewed, events which had occurred at intervals of several or many years and since three quarters of the changes amounting to modification were within a decade of the age at interview, the ease with which exact dates were remembered was not surprising.

A small number of men had obvious difficulty in recalling when a certain job change had been made and /

and in such cases the most that could usually be achieved was to narrow the date down to a particular age decade if the change was early in their working life or to a five-year period if it was more recent.

It is highly probable that some early job changes were forgotten but that very few of these would rank as modification was suggested by the replies of a number of foremen and supervisors to questions on how frequently men in the twenties and thirties sought less heavy work. At these ages such requests were rare in both the foundries and the coalmine. Though the number of recorded modifications in the early decades may be a slight underestimate, this is therefore not reckoned to be a serious source of error.

In presenting the results of this section of the analysis account has been taken of the fact that the maximum age at which an individual could have modified was determined by his age at interview. Table 8 shows the crude relationship between the two ages.

TABLE 8 /

TABLE 8

NUMBERS OF MEN MODIFYING AT EACH AGE BY AGE-GROUPS AT TIME OF INTERVIEW

SF = Small Foundry LF = Large Foundry CM = Coalmine

AGE AT MODIFICATION	AGE AT INTERVIEW																		TOTALS
	50-54			55-59			60-64			65-69			70-74			75-79			
	SF	LF	CM	SF	LF	CM	SF	LF	CM	SF	LF	CM	SF	LF	CM	SF	LF	CM	
20-29		1		1	1			1	1										5
30-39		5	4		2			5		2	1						1		20
40-49	7	19	19	1	7	7	2	6	3		3	1			1				76
50-54	5	10	9	4	9	16		5	3	1	3	2	1		1				69
55-59				7	10	10	1	8	15	2	8	3		1	2		1	1	69
60-64							3	6	7	1	8	10	1	1	1				38
65-69										1	7	8			4				20
70-74													1		2			1	4
75-79																			-

There were five men in whose histories two separate permanent modifications appeared to have taken place; to avoid confusion only the earlier of each pair of modifications has been included and the numbers in Table 8 therefore represent both men modifying and modifications.

In general the older the men were at interview, the later had they modified. It is safe to assume that this relationship is the result of a process of selection; many of the men modifying in the forties and fifties would be unfit or perhaps unwilling to continue at work and their more able contemporaries who reached the sixties before modifying would therefore show a higher average age at move off heavy work, the seventies repeating the pattern at a still higher average age.

To determine the true relation between age and modification within the limits imposed by this selection effect, tables have been constructed to show, for each of the three industrial units, the modification rate at different ages. This rate was calculated by dividing the number of modifications by the total number at risk in each age-range and then /

then reducing the resulting figure to a rate per year. The number at risk during any given period comprised all those who had not previously modified and the tables therefore cover all men interviewed.

The symbols used in the tables are as follows:-

n = number of men entering each age period x with no history of modification

m = number of men modifying in each age period x (x has only two values, 5 and 10 years)

r = crude modification rate = $\frac{m}{n}$

c = modification rate per year for each period = $\frac{r}{\text{length of } x}$

Table 9 shows the modification rates by age at time of interview for each of the industrial groups.

TABLE 9 /

TABLE 9(a)

MODIFICATION RATES - MEN AGED 50-54 YEARS

AGE PERIOD x	SMALL FOUNDRY				LARGE FOUNDRY				COAL MINE				TOTAL			
	n	m	r	c	n	m	r	c	n	m	r	c	n	m	r	c
20-29	22	-	-	-	74	1	.013	.0013	66	-	-	-	162	1	.006	.0006
30-39	22	-	-	-	73	5	.068	.0068	66	4	.06	.006	161	9	.055	.0055
40-49	22	7	.318	.0318	68	19	.279	.0279	62	19	.306	.0306	152	45	.296	.0296

TABLE 9(b)

MODIFICATION RATES - MEN AGED 55-59 YEARS

AGE PERIOD x	SMALL FOUNDRY				LARGE FOUNDRY				COAL MINE				TOTAL			
	n	m	r	c	n	m	r	c	n	m	r	c	n	m	r	c
20-29	19	1	.052	.0052	58	1	.017	.0017	55	-	-	-	132	2	.015	.0015
30-39	18	-	-	-	57	2	.035	.0035	55	-	-	-	130	2	.015	.0015
40-49	18	1	.055	.0055	55	7	.127	.0127	55	7	.127	.0127	128	15	.117	.0017
50-54	17	4	.235	.047	48	9	.187	.0374	48	16	.333	.0666	113	29	.256	.0512

TABLE 9(c)

MODIFICATION RATES - MEN AGED 60-64 YEARS

AGE PERIOD x	SMALL FOUNDRY				LARGE FOUNDRY				COAL MINE				TOTAL			
	n	m	r	c	n	m	r	c	n	m	r	c	n	m	r	c
20-29	10	-	-	-	48	1	.02	.002	39	1	.025	.0025	97	2	.02	.002
30-39	10	-	-	-	47	5	.106	.0106	38	-	-	-	95	5	.052	.0052
40-49	10	2	.2	.02	42	6	.142	.0142	38	3	.078	.0078	90	11	.122	.0122
50-54	8	-	-	-	36	5	.138	.0276	35	3	.085	.017	79	8	.101	.0202
55-59	8	1	.125	.025	31	8	.258	.0516	32	15	.468	.0936	71	24	.338	.0676

TABLE 9(d)

MODIFICATION RATES - MEN AGED 65-69 YEARS

AGE PERIOD x	SMALL FOUNDRY				LARGE FOUNDRY				COAL MINE				TOTAL			
	n	m	r	c	n	m	r	c	n	m	r	c	n	m	r	c
20-29	11	-	-	-	36	-	-	-	27	-	-	-	74	-	-	-
30-39	11	2	.181	.0181	36	1	.027	.0027	27	-	-	-	74	3	.04	.004
40-49	9	-	-	-	35	3	.085	.0085	27	1	.037	.0037	71	4	.056	.0056
50-54	9	1	.111	.0222	32	3	.093	.0186	26	2	.076	.0152	67	6	.089	.0178
55-59	8	2	.25	.05	29	8	.275	.055	24	3	.125	.025	61	13	.213	.0426
60-64	6	1	.166	.0332	21	8	.38	.076	21	10	.476	.0952	48	19	.395	.079

TABLE 9(e)

MODIFICATION RATES - MEN AGED 70-79 YEARS

FOUNDRY AND COALMINE DATA COMBINED

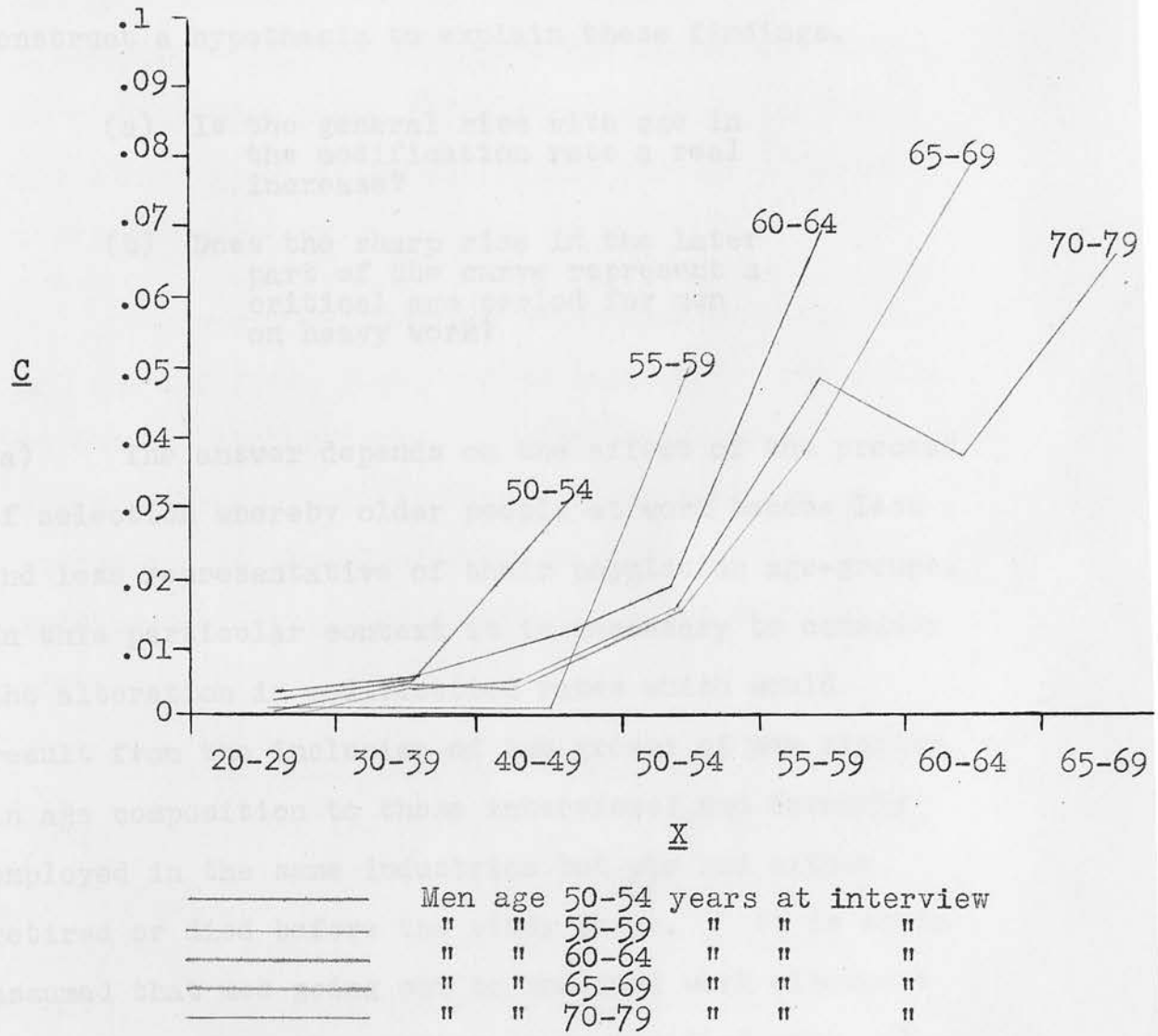
AGE PERIOD x	n	m	r	c
20-29	24	-	-	-
30-39	24	1	.042	.0042
40-49	23	1	.044	.0044
50-54	22	2	.09	.018
55-59	20	5	.25	.05
60-64	15	3	.20	.04
65-69	12	4	.333	.0666

In all the tables there is in each industrial unit a distinct trend in modification; the rate rises from the twenties and as the theoretical maximum age at modification is approached the higher it becomes. In the following graph the curves representing the combined totals for each five-year age group clearly reveal the trend.

GRAPH /

GRAPH OF MODIFICATION RATES BY AGE-GROUPS

C - modification rate
X - age-periods at modification



Men age 50-54 years at interview
" " 55-59 " " "
" " 60-64 " " "
" " 65-69 " " "
" " 70-79 " " "

The striking feature is the similarity of the curves in shape; each begins at a low point on the scale of modification rate, rises slowly and ends with a steep rise. This similarity strongly suggests the operation of some common factor from about the age of 40 years onwards, and it is now necessary to construct a hypothesis to explain these findings.

(a) Is the general rise with age in the modification rate a real increase?

(b) Does the sharp rise in the later part of the curve represent a critical age period for men on heavy work?

(a) The answer depends on the effect of the process of selection whereby older people at work become less and less representative of their population age-groups. In this particular context it is necessary to consider the alteration in modification rates which would result from the inclusion of two groups of men similar in age composition to those interviewed and formerly employed in the same industries but who had either retired or died before the study began. It is again assumed that men going out to modified work elsewhere were balanced by those coming in to modified work.

The /

The first group would comprise those men who had not modified before giving up employment; including these men in the data would raise the number at risk in each age-period up to the time of their retirement without affecting the number of modifications and thus the modification rate would at first be lowered but their retirement would reduce the number at risk thereby producing a sharp rise in the rate. The curves shown in Graph I would therefore become steeper.

The second group to be considered consists of men who modified, continued on less heavy jobs for a period and then retired. The inclusion of such men would raise the modification rate at each age in proportion to the size of their contribution, thereby raising the level, and accentuating the curve, of the slope.

Evidence will later be adduced to demonstrate that losses from the national labour force increase sharply in the later fifties; that being true of the working population from which the foundries and coalmine drew their labour it may tentatively be suggested that inclusion of the first group mentioned /

mentioned above would cause a steeper rise around the middle of the curve of modification rate. The effect of the second group is more difficult to estimate since it is not known at what ages they modify. Reference must again be made to the statements by foremen and supervisors that requests for less heavy work were rare among men in the twenties and thirties and uncommon in the forties. If that information is correct the addition of men who retired after some time on modified work would also produce a more pronounced rise in the later modification rates.

Accurate prediction of the alteration in the slope of the curves shown in Graph 1 is impossible without precise information on the two groups discussed but it is cautiously suggested that the general effect would be to bring the curves into line and raise the steepness of the later modification rates.

(b) It is obvious from the theoretical nature of the answer to question (a) above that the existence of critical age ranges cannot be inferred from the graph with any degree of confidence. If the modification pattern of those who first modified /

modified and then retired resembled that of the men who remained at work, and if those who retired without prior modification did so at ages similar to the national population, then it is probable that the true rate of modification is low in the twenties and thirties, begins to climb in the forties, and thereafter rises more and more steeply.

5. The Aetiology of Modification

(a) The role of Illness and Injury

62% of the men who had moved to less heavy work declared that an illness or injury had been responsible. The proportions in the three industrial groups are shown in Table 10.

TABLE 10

GROUP	SMALL FOUNDRY	LARGE FOUNDRY	COAL MINE	TOTAL
Proportion of modifications associated with illness or injury	26 out of 41 63%	73 out of 129 57%	84 out of 131 64%	183 out of 301 62%

Standard error of 62% (in samples of 41 = 7.8%
(in samples of 129 = 4.3%
(in samples of 131 = 4.2%

The variation between the proportions is remarkably small. The finding that almost two thirds of the moves off heavy work were associated with some departure from health is probably an underestimate since care was taken to exclude uncertain associations.

Doctors are familiar with the tendency to implicate health when a change of work is being sought; an individual may genuinely believe that his job is detrimental to his health yet objectively no such evidence can be found. With this in mind every claim that modification had been made on health grounds was examined at interview; the claim was accepted only if either the medical diagnosis or an adequate description of the ailment was forthcoming.

The nature of the illness or injury varied from trivial to severe. There were cases in which the need for a change of job had been indisputable on grounds of major disability but a most interesting type of history was that of a move off heavy work following a minor injury or illness from which recovery had been both rapid and complete. It /

It appeared that many men carried on in heavy work under increasing strain until a 'crisis-factor' such as illness or injury supervened and the decision to modify was made. Some of the histories strongly suggested that the influence of work-mates, family, or medical adviser was an important consideration in reaching that decision.

Illness and injury bore a stronger relation to modification at different ages: the combined figures are set out in Table 11.

TABLE 11

ASSOCIATION BETWEEN ILLNESS OR INJURY AND AGE AT MODIFICATION

AGE AT MODIFICATION	ASSOCIATION BETWEEN MODIFICATION AND ILLNESS OR INJURY		TOTALS
	PRESENT	ABSENT	
20-29	5 100%	-	5
30-39	15 75%	5 25%	20
40-49	49 64%	27 36%	76
50-59	75 54%	63 46%	138
60-69	36 62%	22 38%	58
TOTAL	180 60%	117 40%	297

$\chi^2 = 7.76$ n = 4 P = .10

With rise in age at modification, illness and injury tended to become less important relative to other factors. In the twenties and thirties modification was in every case associated with severe disability; though only a rough assessment of the degree of disability was possible it was quite evident that modification from the forties onwards was associated with a decreasing average level of disability. This point will be taken up later.

(b) Other factors in modification

At interview it was often clear that for reasons of prestige men were anxious to justify their having moved off heavy work and were inclined to invoke rather specious factors. The use of such vague expressions as "strain", "my age", "shortness of breath", "fatigue" was common but one point clearly emerged - the actual move to less heavy work was often preceded by a period of weeks or months during which the individual became increasingly aware of the heaviness of his work. What finally decided the request for a lightening of effort was obscure but an occasional clue was discernible. The sudden death or illness /

illness of a fellow heavy worker was mentioned by seven men as having influenced them to seek lighter work "before the same thing happens to me"; twenty-five miners stated that they had sought lighter work following the close-down of their last colliery; the falling vacant of a job where the duties were known to be light was given as the deciding factor by five men.

Excepting those men in whom severe disability had precluded return to former work, there was a similarity about the pattern of modification whether this had followed illness or not. There often seemed to be a preliminary period of increasing awareness of the demands of heavy work, the actual modification being determined by an event such as illness, injury, redundancy or some external reminder of the supposed effects of increasing age.

The question that arises from these observations is to what extent does modification reflect a change in physical fitness for, or a change in attitude to, heavy work? Since neither physical fitness nor attitude to work was assessed before and after /

after modification it is not possible to give a direct answer but of those men who attributed modification to illness or injury 56% in the foundries and 52% in the coalmine stated that no permanent disability had resulted. If there was a temporary depression of physical fitness but attitude to work remained constant then a temporary modification would have been expected among those men who recovered fully. That a permanent move to less heavy work followed the very wide range of illness and injury observed strongly suggests that these modifications can not be explained solely in terms of change in physical fitness.

From the small amount of evidence obtained on the other associations with modification it would be hazardous to generalise. Reference has been made above to the admission that feelings of 'strain' or 'fatigue' had preceded the move off heavy work and to the apparent decisive role of various chance events. From the considerable number of vague explanations offered by men modifying without a history of associated illness or injury one expression recurred again and again; /

again; "my age" was seemingly considered quite an adequate reason for modification. If this conventional belief is as strong elsewhere as it was in both the foundries and the coalmine, it will be no easy task to alter it.

(c) Speed of Work

All men whether they had modified or not were invited to mention any features of their work which caused or had caused difficulty as they grew older. The outstanding point in the replies was the effect of speed in work.

In the foundries two main groups of men, iron-moulders and stove-fitters, were paid by individual piece-rates.

The moulders worked in pairs in order to assist each other with heavy lifts and as far as possible men of about the same age were selected as 'neighbours'. This arrangement worked well enough on the whole but of the 58 moulders who had modified, 5 gave as their reason the strain of trying to keep up with the faster pace of their younger neighbours. But even where the moulders were evenly matched the rate of work necessary to maintain earnings was high, and this /

this together with the strenuous effort required at each stage of the cycle of operation made the occupation one of the heaviest in the industry. The moulders were unanimous that with increasing age the continuity of piece-work imposed greater strain upon them and they had no hesitation in defining suitable work as that which allowed the moulder to regulate his own speed of work.

17 stove-fitters who had moved off piece-work were interviewed; though less strenuous than moulding the rate of work was also rapid. Some years previously the stove-fitters had worked in small groups, the piece-rate earnings being calculated on the group output. 4 of the fitters interviewed had given up that system of piece-work and it later transpired (from information given by the management) that these four had been moved at the request of the other and younger members of the group who complained that they were too old (all were in the late fifties) to keep pace and were therefore hindering the earning capacity of the group.

From the interviews with miners the effect of speed was again evident. To reach the coal face or rock heading a walk of one mile or more from the /

the pit bottom was necessary - personal experience on some twenty occasions confirmed the strenuous nature of this task. The cause of difficulty for the older men was not the distance but the pace at which it had to be covered; it was usual for the men to walk to the coalface in small groups of about ten and since the earlier the face was reached, the quicker could the work be completed, a smart pace was set. With an occasional striking exception, older men found increasing difficulty in keeping up with the pace set by younger men and this they maintained was commonly the reason for the decision to seek work nearer the pit bottom or work to which they could proceed at their own speed.

"At my job I'm alright" was repeatedly heard at interview and was confirmed during personal visits to the coalface where men in the late fifties who complained of severe shortness of breath on the hill up to the pit and on the way to the face were observed stripping coal without visible distress. At the coal seams rest pauses were largely under the individual's own control as they were on lone journeys to and from work.

During /

During the discussion of difficulty with age, the adjectives 'light' or 'lighter' were frequently used and it seemed worthwhile to ascertain what they comprised. From the opinions expressed two definitions emerged. In an absolute sense light work often meant work where effort of any kind was minimal but from those with good insight a more useful definition was obtained. Discontinuity of effort was the essential requirement of lighter work for men in a variety of heavy and medium occupations. This was confirmed by inspection of pre- and post-modification jobs in both foundries and coalmine. Provided the effort was broken up by rest pauses, the actual intensity of exertion seemed to be of secondary importance.

6. Age and Health

The attempt to assess individual health was made for two reasons, firstly to see if the health distribution of older men at work in heavy industry varied with age and secondly to observe the relation between health and kind of work.

The /

The assessments were based on accounts of past and present health supplemented by observations at interview. From the tabulated replies men were assigned to one of three categories:

Category A - Men in good health

Criteria - No past illness or injury affecting present health
Unqualified statement that present health satisfactory
Not receiving medical attention
No symptoms or disabilities

Category C -

Criteria - History of past illness or injury affecting present health
Present health stated to be other than good
Recent medical attention
Presence of substantial disability restricting capacity for effort

Category B -

Criteria - General health good
Presence of local disability

(The presence of a minor temporary ailment such as a cold was ignored in making the assessment).

The majority of assessments were easily categorised; with those who lay near the borderline between categories some difficulty was inevitable but /

but from the outset it was recognised that consistent assessment was of the utmost importance if even broad conclusions were to be drawn. No conscious consideration of the work being done was taken into account and allowance for age was left to the individual.

Observation of disability was noted at the interview or during the job inspection visits but actual categorisation was left until memory of the individual had faded; it was felt that impressions made during interview might introduce bias if tabulation of the findings was made at the time. The assessments were checked on three occasions with intervals of several months between and it was found on each recheck that 94% of the assessments were consistent.

TABLE 12 /

TABLE 12

HEALTH CATEGORY BY AGE GROUPS

COMBINED FOUNDRY DATA

AGE AT INTERVIEW	HEALTH CATEGORY			TOTALS 100%
	A	B	C	
50-54	67 70%	28 29%	1 1%	96
55-59	49 64%	21 27%	7 9%	77
60-64	30 52%	24 41%	4 7%	58
65-69	31 66%	13 28%	3 6%	47
70+	7 64%	3 27%	1 9%	11
TOTALS	184 64%	89 31%	16 5%	289

$\chi^2 = 10.31$ n = 8 P = .20

TABLE 13 /

TABLE 13

HEALTH CATEGORY BY AGE GROUPS

COALMINE

AGE AT INTERVIEW	HEALTH CATEGORY			TOTALS 100%
	A	B	C	
50-54	49 74%	14 22%	3 4%	66
55-59	31 56%	22 40%	2 4%	55
60-64	17 44%	20 51%	2 5%	39
65-69	17 63%	10 37%	- -	27
70+	13 100%	- -	- -	13
TOTALS	127 63.5%	66 33%	7 3.5%	200

$\chi^2 = 20.53$ $n = 8$ $P = .01$

The association between age and health category is stronger in the coalminers than in the foundrymen but there is a distinct similarity between the distributions of men in Category A in the two tables.

The proportion of men in good health declines to the early sixties and then rises in the age 60-65 group, the upward trend continuing in the /

the coalminers over age 70.

The explanation of these findings lies in one or both of two possibilities.

Firstly the declining numbers at work indicate separation from the respective labour forces. This separation is due to the combined effect of death, retirement and unemployment assuming that men leaving to work elsewhere were balanced by incomers of the same age. The contribution from deaths would be small and need not be further discussed; the remainder will for convenience be referred to under the heading of 'losses'.

That losses alone were not responsible is evident from the absolute increase in numbers from one age group to the next in some of the categories; in Table 12 there are three such increases and in Table 13 there is one increase showing that another factor is in operation.

Secondly, there is the effect of increasing morbidity with rise in age. If for the moment the possible effect of losses is ignored and the proportions are considered, morbidity cannot alone account for the findings because the proportion of /

of men in Category A rises at age 65.

Therefore the changes with age in health distribution must be due to a combination of losses from the labour force and a decrease in the average level of health at each age. How much each contributes cannot be estimated but it is fairly certain that the managerial attitude to older men in both foundries and coalmine is reflected in these tables. The policy was to retain at least up to the age of 65, all who wished to work provided they could do some useful task, and to that end certain jobs were virtually reserved for older men. After age 65 the concessions appeared to become rather less generous.

With that policy in mind, a decreasing average level of health from the fifties onwards is not unexpected. The abrupt rise in group health in the 65-69 age group suggests that the less fit men had given up work on reaching retirement age leaving their fitter contemporaries to continue for a few more years. For this inference a little support was obtained at interview; a number of men in the B and C categories who were a few years below retiring age indicated that despite their disability, they /

they intended to continue in work until age 65 when both contributory and company pensions would begin.

7. Age, Health and Work

The last association to be examined is between state of health and heaviness of work. Tables 14 and 15 set out the comparison by decades of age between the work distributions in each of the three health categories.

TABLE 14

FOUNDRIES

H - Heavy Work M - Medium Work L - Light Work

AGE GROUP	CATEGORY A			CATEGORY B			CATEGORY C		
	H	M	L	H	M	L	H	M	L
50-59	43 37%	58 50%	15 13%	4 8%	22 45%	23 47%	-	6	2
60-69	13 21%	35 57%	13 21%	3 8%	20 54%	14 38%	1	2	4
70+	-	6 86%	1 14%	-	-	3 100%	-	-	1
TOTAL	56 30%	99 54%	29 16%	7 8%	42 47%	40 45%	1 6%	8 50%	7 44%

$\chi^2 = 7.86$
n = 4
P = .10

TABLE 15

COALMINE

H - Heavy Work M - Medium Work L - Light Work

AGE GROUP	CATEGORY A			CATEGORY B			CATEGORY C		
	H	M	L	H	M	L	H	M	L
50-59	56 70%	17 21%	7 9%	15 42%	14 39%	7 19%	2	2	1
60-69	15 44%	11 32%	8 24%	3 10%	13 43%	14 47%	-	-	2
70+	2 15%	7 54%	4 31%	-	-	-	-	-	-
	73 57%	35 28%	19 15%	18 27%	27 41%	21 32%	2 29%	2 29%	3 42%

$\chi^2 = 17.85$
$n = 4$
$P = .01$

The smaller proportion of men on heavy work in Categories B and C is expected in view of their disability. The finding of note is that among the men in good health there is a steady decline with age in the proportion on heavy work; in the foundry data the level of significance is below the conventional 5% but in Table 16 it is high enough to make chance an unlikely explanation.

It /

It is of course doubtful whether Category A is synonymous with fitness for heavy work but it does appear that the decline with age in the proportion of men on heavy work cannot be attributed to state of health per se. It has already been shown that from age 65 the proportion of men in good health actually increases but in Tables 14 and 15 it is evident that the declining trend in work heaviness continues into the seventies.

DISCUSSION

Reference was made in the Introduction to the methodological difficulties which confined this study to older people at work. The resulting restriction on interpretation of the data has been discussed in the preceding section; while giving due attention to that restriction it is now appropriate to see how far answers to the four questions posed at the outset of the study are permissible.

1. Are older men doing less heavy work than younger men?

There seems no doubt that, as between the fifties, sixties and seventies, the answer is in the affirmative - in terms of the average at each of the age ranges observed. It is, however, important to note that 'less heavy' and 'light' are not synonymous; there were proportionately fewer men on light work in the sixties and seventies than on moderate work and frequent inspection of the latter provided ample evidence of the ability of many older men to perform efficiently work requiring considerable activity.

In the foundries and the coalmine opportunity for transfer to less heavy work was probably greater /

greater than the nature of the work would suggest. Comparisons between proportions of men over a given age in different industries are apt to be misleading owing to the variation in retirement policies but within the coalmining industry a comparison shows that the proportion of the labour force aged 65 years and over at the colliery visited was 4.1% compared with a proportion of 3.3% in the total coalmining labour force in the same year (National figure obtained from returns by the National Coal Board). Given the determination to do so, a management in even the heaviest industry can apparently achieve a significant increase in the number of older men retained in employment.

It has been shown that the reduction in the average level of work heaviness with increase in age is due to a combination of retirement and work modification by those still at work. How much each event is responsible is not known since modification must often precede retirement. In a sense retirement <u>is</u> a form of modification but moves to less heavy work must be reckoned an important subject for study in themselves for they appear to be one way of retaining older men in employment. Furthermore it /

it is obvious that the ranks of the retired are filled from those at work and study of the modification pattern of the latter will yield useful information on the pre-retirement period.

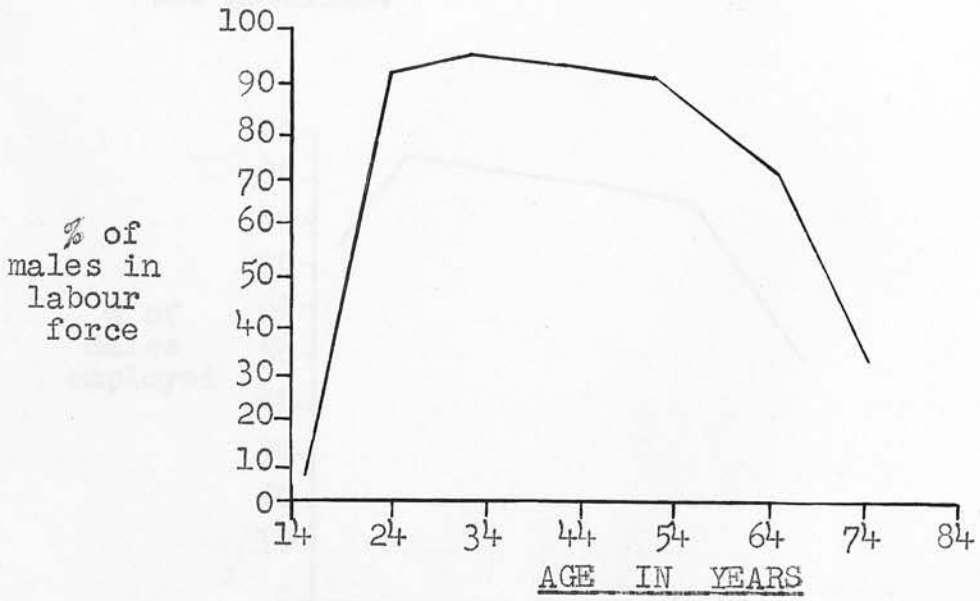
2. Moves off Heavy Work

That older men move to less heavy work is well known. This study has endeavoured to give some precision to that general impression; if the assumptions about retirements are correct then the data presented show clearly that the incidence of modification is negligible in the twenties and thirties, begins to rise in the forties, and thereafter rises steeply.

The assumptions made were discussed on page 71; reference was made at that point to recent evidence on the ages at which separation from the labour force takes place. That evidence is shown in the following three diagrams:

(a) /

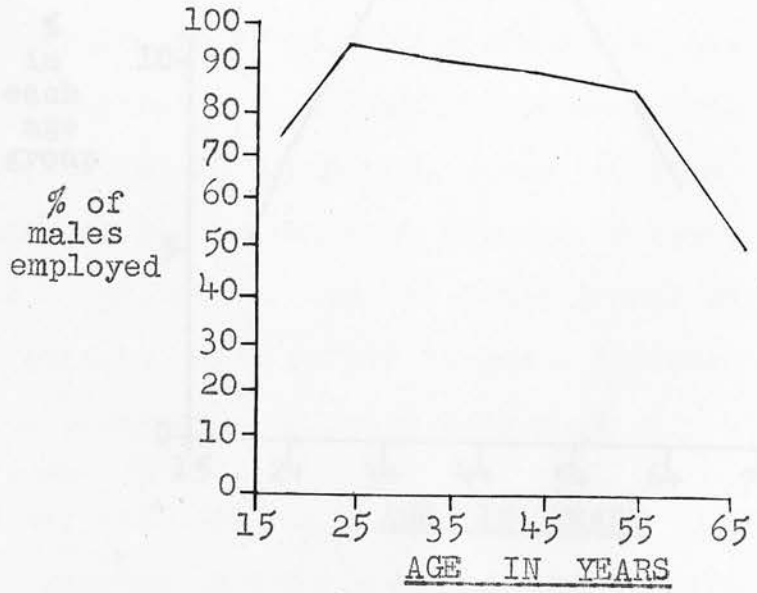
(a) Wolfbein (1950) constructed the curve of separation from data obtained at the 1940 census in America.



Between the ages of 54 and 64 years a sharp increase begins in the proportion of men leaving the labour force.

(b) /

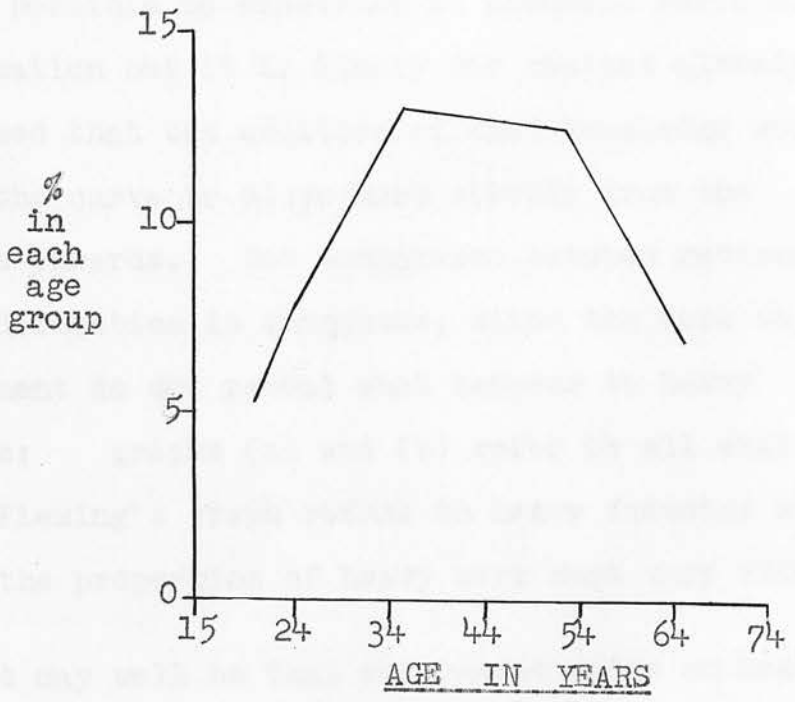
(b) No exactly comparable figures are available for British males but by relating Ministry of Labour estimates (1950) of the total number of male employees in England and Wales to the total male population of England and Wales in 1950 as estimated by the Registrar General the following curve was obtained:



There is a fair similarity between the two curves, the separation being slight up to the early fifties and thereafter increasing rapidly.

(c) /

(c) Fleming (1952) analysed the age-structure of some 36,000 male operatives employed in the Sheffield Iron and Steel Industry. The percentages in each 5-year age-group are shown below:



According to Fleming the male age structure of the Sheffield Area is almost identical with that of England and Wales which does not show the decided hump in the late fifties. Thus for one of the heaviest industries the same trend of retirement (using that term in a wide sense) is evident - a sudden increase in the late fifties and early sixties.

There /

There is a resemblance between these curves of separation and the curves of modification rates plotted on page 69. Owing to absence of knowledge on modification by those who had retired it is not possible to construct an accurate curve of modification but it is likely for reasons already discussed that the addition of that knowledge would cause the curve to slope more steeply from the forties onwards. But comparison between retirement and modification is dangerous, since the data on retirement do not reveal what happens to heavy workers; graphs (a) and (b) refer to all employees while Fleming's graph refers to heavy industry within which the proportion of heavy work must vary widely.

It may well be that retirement rates on heavy work are greater or that preceding modification brings the rates into line with the general industrial pattern, but it seems clear that both retirement and modification rates begin to rise some years before the national pension age of 65 years is reached. Reference was made on page 3 to the Social Survey finding of an average age at retirement of 62 years; in the present study the use of averages has been avoided because of uncertainties in sampling but it /

it is worth mentioning that the average age at modification was 52.5 years (Standard Deviation 8.9).

These facts serve to emphasize that the problems of employing older workers arise somewhat earlier than is currently believed. When accurate data is available on retirement in heavy occupations it is likely that the complete picture will reveal that the problem for older men in heavy work has an even earlier onset than in industry as a whole.

3. Factors in Modification

Though illness, injury or disability resulting therefrom was stated to be the 'cause' of some 60% of moves off heavy work, scrutiny of the nature of the ailment together with the frequent admission that strain had preceded the actual modification left very little doubt that illness or injury, especially if accompanied by absence from work, often acted as a 'crisis-factor'.

It appeared from the histories of those with good insight that the decision to seek less heavy work was often the result of some external suggestion by workmates, members of family or a member of the /

the medical profession, acting on a mind made more receptive by absence from work. It is of course common experience that during such absence from work the subjective capacity for physical effort declines and has to be restored by a graduated return to work but the nature of the objective psychological and physiological changes taking place is obscure.

In his Linacre Lecture on Old Age, Rolleston (1922) observed that after an illness old age often comes on apace. Is it possible that there are detectable changes in fitness and skill during and following absence from work through illness and injury even when clinical recovery is complete? No answer can be given at present but this would seem to be an important matter for future investigation. Further speculation on the exact role of illness and injury is useless but the findings show that considerable caution is required in speaking of these factors as 'causes' of modification.

Of the other factors responsible even less is known but a certain similarity was noted between modifications preceded by illhealth or disability and some of those where no such history was obtained.

The period of strain or increasing awareness of the demands of heavy jobs again emerged as the predisposing cause, the actual modification appearing to follow some chance determined event. The remainder seemed to be convinced either that they had not modified at all, which could be correctly described as wishful thinking, or that a move to less heavy work was the right thing to do in the fifties and sixties.

It cannot be too much emphasized that conventional beliefs about age and heavy work exerted a powerful influence among many of the men interviewed. One of the most formidable tasks in the campaign to retain older workers in heavy industry will be to reduce the wastage of skill, and possibly also of efficiency, which results from an emotional rather than a rational attitude to heavy work. There is one direction in which this could be achieved - the alteration of payment-by-results to suit the older worker.

Increasing mechanisation with its attendant acceleration of production speeds is extending the range of jobs to which piece-rates, output bonus schemes and other incentives can be applied. These devices assume that high speeds of work are possible /

possible, an assumption justifiable in younger people but now known to be less and less correct as age increases. That time-rates are preferable to older men even when they imply a substantial drop in wage, was abundantly clear from personal opinions expressed at interview. For example ironmoulders and coal strippers frequently abandoned their skills - skills which had required many years of training - because the pace of work set by younger men was too rigidly high for their capacity.

Discussion with the foundry and mine managements revealed the numerous difficulties which will have to be overcome if older men are to continue at their skilled tasks and at the same time be allowed some reduction of effort. But it would surely be more efficient and more useful to keep skills in action at a lower level of output than to allow the present drift toward less skilled work to go on.

During the study two interesting examples of the proper use of older skilled men were noted. In the coalmine a few of the older strippers were transferred to a training coalface where the assistance of the young trainees reduced the effort and to which /

which the journey from the pitbottom was rather less hurried while in the large foundry several of the older men had been transferred to a new mechanised foundry where, although the pace of work was strenuous and only younger men were recruited, their skilled knowledge of ironmoulding enabled them to supervise without actually expending much effort.

These illustrations serve to emphasize an important principle for older men on heavy work - modify the effort but preserve the skill.

4. Health and Work

Crude though the health assessments inevitably were, the findings emphasize the fallacy of the view that heavy industry cannot employ unfit men. One third of the whole group of men interviewed had disability in the sense that they had some loss of function and about 5% were severely restricted in the work they could do. To illustrate what an enlightened management can achieve it is only necessary to mention that there were seven men suffering from marked angina pectoris all of whom /

whom were so placed in modified work that they continued to exercise their skill.

Even in the coalmine where jobs requiring little effort were few, by dint of an energetic placement policy many older individuals were suited in work. The problem in the colliery was aggravated by the fact that breathlessness on effort was a very common reason for the request to be moved to less heavy work; eight miners were certified pneumoconiotics but at least twice that number were probable sufferers from dust disease and the combination of dyspnoea due to ageing and to disease placed severe limitations upon such men.

Examination of the tabulated data suggested that retirals at age 65 were mainly among the men in the disabled categories. Owing to the inaccessibility of those who had already retired it was unfortunately impossible to determine whether they had done so on health grounds, because suitable work was not available or because they had no inclination to continue in employment beyond pensionable age. But it was noticeable that the men still at work over 65 years of age had a "why should I retire" attitude /

attitude to their jobs, and it has been shown that some three-quarters were on modified work, and that of those who had not modified a large majority were skilled men.

Finally, it is appropriate to re-consider the introductory recommendations on work-suitability for older men. It was shown from research on Skill and Fitness that work which demanded high speeds of performance and high energy expenditure respectively is in general unsuitable for older people. It might be expected that when these conditions are combined older people would tend to move off such work.

In both foundries and coalmine many older men were consciously aware of the strain imposed upon them by heavy work and it appeared that their notion of heaviness comprised in varying degree the conditions mentioned above. Modification may therefore represent a process of adjustment to psycho-physiological strains and if that hypothesis is correct the main problem becomes one of permitting the adjustment without sacrificing the productive /

productive skills involved. From the high incidence of modification revealed by this study it is clear that the problem is a large one and the solution is probably to be sought in a more refined form of modification than the crude and abrupt transfer so evident in the records from which the foregoing analysis has been made.

By way of peroration the words of Sir Frederick Bartlett - than whom none is better qualified to speak - are fitting:

> "But it can be regarded as certain that, given adequate medical care and given a proper regard for the conditions of training and work which are appropriate for the particular age-ranges concerned, the great bulk of the members of any modern community ought to be able, over the whole of a full life-span, to continue to contribute to the productive skills which are essential in such a community, and to do so without undue fatigue or strain, but to their own happiness and satisfaction".

SUMMARY

A. Introduction

1. The Employment of Older People is a pressing national problem.

2. The core of this problem is how to retain older workers in industry. An important part of the solution lies in defining what kind of work is most suitable for people in the upper age ranges; an endeavour is made to reach such a definition in the light of known changes with age in Skill, Fitness and Motivation.

3. The fundamental nature of human skill as revealed by recent research in experimental psychology is reviewed. Laboratory and field findings on the effect of ageing are described and the following practical conclusions drawn:

   (a) The average speed of work declines from the age of 30 but increasing accuracy can compensate for this provided the pace of work is under the individual's own control.

   (b) Since skill is more easily maintained than acquired in middle age and later, the aim should be to modify the conditions of work and allow the skill to be exercised rather than move the older individual to work where training difficulties will discourage him.

   (c) /

(c) The possession of industrial skill places the older man in a slightly more favourable employment position at present but it is evident that age rather than skilled ability is the major consideration with many employers. It appears that there is an unexplained drift in the higher age ranges towards unskilled work.

4. Age changes in physical fitness, as measured by various test indices, are summarised. The general findings are:

(a) With increasing age the capacity for maximal work declines more sharply than the capacity for moderate effort and from both the recovery time becomes longer.

(b) At a given level of effort older men are nearer to their physiological limits than younger men.

Attention is drawn to the points which make the application of test results to industrial situations very difficult and the limited conclusions are drawn that rest pauses should be more frequent for older people and that their level of energy expenditure should be somewhat lower. It is emphasized that knowledge of the physical demands of industrial work is urgently needed.

Lastly the effect of training is noted and the view put forward that older men accustomed to heavy work are likely to be more fit for active work than those used to sedentary occupations. Again the importance of the individual within each age-group is mentioned.

5. /

5. Of changes with age in willingness to work and interest in work little is known but recent experiments by industry are referred to and the importance of accurate observation of these innovations is stressed.

6. From the industrial standpoint the Employment of Older People presents problems which vary in nature. Heavy industry is popularly believed to present the greatest difficulties for older people; the scanty evidence on age and heavy work is discussed and the field for study narrowed to that aspect of the wider problem.

7. Four questions are defined -

   (a) Are older people doing less heavy work?

   (b) At what age do they move to less heavy work?

   (c) With what factors are these moves associated?

   (d) What is the state of health of older people in heavy industry?

B. /

B. Observations

1. The method of study is outlined and reasons are given for choosing the least complete of the alternatives. Personal interview of men aged 50 years and over in two foundries and a coalmine followed by simple analysis of their jobs formed the basis of the investigation. At interview health and occupational histories were obtained and the reliability of the information and the various assessments is discussed.

2. The material for study eventually comprised the records of 489 men. The sampling is described and an indication given of the nature of the industry and of the managerial policy towards older workers.

3. It is shown that between the fifties and the seventies, the proportion of men on heavy work declined and this is explained as the result of losses from the labour force and of moves to less heavy work. To these moves the term 'modification' has been applied.

4. Among men in the foundries who had not modified, the average level of skill rose from the 50-59 age-group to the 70 and over age-group but in those who had modified it was evident that there was a marked associated decrease in the average level of skill. This was due to the large number of iron-moulders in the sample, an occupation which was both skilled and heavy.

5. /

5. To determine at what age modification was most frequent, tables have been constructed to show the incidence of that event in the past history of the 489 men. The probable effect on these modification rates of including men already retired is examined and the tentative conclusion drawn that moves off heavy work are uncommon in the twenties and thirties, become noticeable in the forties and increase sharply from the fifties onwards.

6. Almost two thirds of the modifications had followed an illness or injury, such an association becoming rather less common as age at modification increased. The hypothesis is advanced that illness or injury acted as a 'crisis factor'.

7. It appeared that modification was sometimes preceded by a period of strain, the actual decision being determined by chance events. Some of these are discussed and the similarity between modifications preceded by illhealth and those not so preceded is noted.

8. The active dislike by older men of high speeds of work or tasks where the pace was not easily self-regulated is emphasized and the older man's idea of lighter work is presented.

9. Broad categories of health were devised and it is shown from their analysis that some two-thirds of the whole group were in good health. It is suggested that the rise at age 65 in the average level of health is due to retirement of some of the less fit men.

10. The decline in the proportion of men on heavy work is shown to apply both to the healthy and less healthy groups.

C. Discussion

1. Attention is drawn to the resemblance between the curve of separation from the labour force at different ages and the curve showing modification rates by age. The latter curve, when allowance is made for retirement, rises sharply in the fifties whilst the former shows a marked increase in the labour force losses from the late fifties onward. It is emphasized that the problem of employing older people arises earlier than national pension age.

2. The prominent but uncertain role of illness and injury in modification appears to merit further investigation.

3. The effects of popular beliefs about age and heavy work are discussed and the need to prevent wastage of skill consequent on moves to less heavy work is emphasized. In particular some reduction in the speed of work for older people is called for and examples of limited achievements in this direction are cited.

4. The opinion that, with enlightened management, heavy industry can employ a substantial proportion of disabled older men is expressed - at least up to the age of 65 years.

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